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NEW METEORITES

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NEW METEORITES.

BY OLIVER CUMMINGS FARRINGTON.

AHUMADA

This meteorite was found in the spring of 1909, 60 miles east of Ahumada, State of Chihuahua, Mexico. The latitude and longitude of this locality are 30° 40′ N., 105° 30′ W. Nothing is known of the time of fall of the mass. Although extended search was made in the region for other masses, none was discovered. Through Mr. Lazard Cahn the single mass found was procured entire by the Museum (Mus. No. Me 780). Its weight was 116 lbs. (52,548 grams). The general shape of the mass is irregularly ovoid, its longest diameter being 17 inches (43 cm.) and its diameter at right angles to this 10 inches (25 cm.). The surface is irregularly roughened and pitted, but was probably somewhat modified by weathering. The meteorite is an iron-stone composed of a spongy mass of nickel-iron the pores of which are filled with chrysolite. In weathering, the chrysolite has yielded first so that the metal projects in points and ridges. Some portions of the surface appear to retain pittings produced during the aerial flight of the mass but these may be due to weathering. The general appearance of the mass is shown in Plate I, Fig. 1, and the appearance of a section in Fig. 2 of the same plate. The meteorite is a pallasite of Brezina's Rokicky group, and is the first iron-stone meteorite thus far reported from Mexico. The chrysolite of the meteorite is dark, nearly black in color, and as it appears in sections occupies relatively greater space than the nickel-iron. Some of the chrysolite masses are of large size, one noted being 1 inch (2.5 cm.) in diameter. Their outlines as seen in section are nearly always angular rather than rounded although some are irregularly rounded. Still the angular character of the chrysolite is not so strongly marked as in Eagle Station for example and the meteorite, so far as this character is concerned, may be regarded as more or less intermediate between the Krasnojarsk and Rokicky pallasites. While the chrysolite of the interior is dark and opaque, on the outer border of the meteorite, where it has been exposed to weathering, it is reddish brown. In small grains it is transparent and colorless to smoky green. Penetrating the substance of the grains, at times irregularly and again in more or less parallel layers, a black, opaque substance may be seen. The presence of this undoubtedly

gives the chrysolite masses their opaque appearance. As grains of the chrysolite are readily attracted by the magnet, it is probable that this substance is magnetite. On etching the metallic portions of the meteorite the three alloys of the trias are seen to be present with kamacite largely predominating. The alloys are irregularly distributed but in general kamacite in bands 1–3 mm. wide is found bordering the chrysolite. Between the kamacite bands in the metallic portion a narrow dark-gray field of plessite usually occurs, separated from the kamacite on all sides by a thin ribbon of taenite. The outline of the fields of plessite does not follow the direction of the adjoining edge between the chrysolite and kamacite. It is usually broadly sinuous. In other portions of the metallic areas a different arrangement of the trias occurs. Broad, irregularly shaped kamacite bands separated by narrow fields of plessite run more or less at right angles to the direction of the chrysolite border. The bands have swollen, rounded outlines and tend to subdivide into twos and threes. Well-marked ribbons of taenite surround the bands and their subdivisions. Figures of this character may be noted near the lower left-hand corner of the section shown in Plate I, Fig. 2. Of accessory minerals there is little evidence. A silver-white, rough, metallic mineral which is probably schreibersite occasionally cuts across the nickel-iron and chrysolite without affecting the structure of either. It also occasionally occurs as a thin layer between the nickel-iron and chrysolite. The specific gravity of a section of the meteorite weighing 65 grams was found to be 4.76. This indicates that the nickel-iron and chrysolite are in about equal proportions by weight.

ARISPE

In 1902 Ward* described an individual of this fall having a weight of something over 40 kilograms, the exact weight not being stated. This seems to have been the only individual of the fall known at that time, but the writer has since learned through Mr. Edward E. Noon, a mining engineer of Sonora, Mexico, of two more masses which evidently belonged to this fall. One of these weighing 62 kilograms (116 lbs.) is now in the collection of the United States National Museum, the other weighing 9 kilograms (20 lbs.) came into the collection of this Museum through the kindness of the late Prof. W. P. Blake. (Mus. No. Me 781). Mr. Noon, who procured both these additional masses, informs the writer that they were found in 1896 about 25 miles northwest of Arispe. Ward gives the locality of the individual which he described as about 15 miles northwest of Arispe and the date of find as 1898. The proximity of the

* Proc. Rochester Acad. Sci. 4, 82–86.

two localities and the similarity of the etching figures leave no doubt that the three masses all belong to a single fall. The 20 lb. mass is of an ovoid form with the dimensions 4 x 6 x 8 inches. Saucer-shaped pits about two inches broad give the surfaces a generally concave character except where the edges of the pits form sharp and often elongated ridges. The etching figures are entirely similar to those described by Ward for the larger mass.

BISHOP CANYON

This meteorite (Mus. No. Me 1955) was obtained from Mr. C. D. Heaton, who stated that it was found by a Mr. Hammond in 1912 near Bishop Canyon, San Miguel Co., Colorado. The exact locality of the find was four miles west of Bishop Canyon and seventeen miles west of the Dolores River. The locality is near the Utah line. Although Bishop Canyon is not shown on ordinary maps it is an established name in the region and seems, on this account, to be a better name for the meteorite than the indefinite ones Dolores River or San Miguel Co. which might otherwise be suggested. The meteorite is of iron and its weight is 19 pounds (8,607 grams). It is a complete, single individual and is all that is known of the fall. The form may be described as a roughly triangular pyramid terminating at the summit in an edge rather than a point. The height of the pyramid is about six inches (15 cm.) and the length of each side of the base is about six inches also. All the surfaces show considerable pitting, those upon the sides of the meteorite agreeing in a general way with one another and differing from those of the base. On the sides of the pyramid the pits vary in size and shape and their junctures produce irregular projections and ridges; on the base the pits tend to be circular, of rather uniform size, and their points of union project in cone-like forms. These different markings appear to the writer to indicate an orientation of the meteorite. The base of the pyramid appears to have been the rear side in flight, and the apex of the pyramid the front side. The different appearances of the two surfaces are shown in Plate II, the upper figure giving a side view of the pyramid, the lower its base or rear side of the meteorite. As usual, the mass was more or less marred and cut by the finders in an effort to determine its nature. The surface shows to some extent a reddish oxidation, but this does not penetrate to any great depth and the original pittings are in general so well preserved that a rather recent fall is indicated. Only a single small fragment having a surface of about one sq. in. (2.5 sq. cm.) has been cut from the meteorite. This shows a nickel-white color and on etching displays fine octahedral figures. These, on account of the

direction of the section, intersect nearly at right angles. Owing to there being little difference in color in the members of the trias the figures are not striking, but their elements are easily distinguishable. The kamacite bands are short, straight, and unequally grouped. The kamacite is granular. The taenite ribbons are narrow but border the bands regularly and show no tendency to anastomose. The fields are scattered but tend to be of relatively large size. Often, field-like spaces are filled with kamacite, distinguished from similar fields of plessite by a lighter color. The plessite of the fields is of uniform color and texture and homogeneous. A single, small inclusion of a rectangular form, of troilite constitutes the only accessory mineral observed. A qualitative test of a dissolved fragment of the meteorite reacted for nickel. A quantitative analysis of the meteorite has not been made as yet.

DAVIS MOUNTAINS

This meteorite was found in the northern end of Davis Mountains, Jeff Davis County, Texas, in 1903, by George Duncan, Jr., then a lad of seven years. The locality of the find, as nearly as it can be determined by the writer, was Lat. 30° 55′ N., Long. 104° 5′ W. The Davis Mountains are shown on the Valentine sheet of the topographic maps of the U. S. Geological Survey. The unusual nature of the mass was recognized later by Mr. George H. Duncan of Toyah, Reeves County, Texas, a town about 50 miles northeast of the place of find, and in 1913 he had it brought to Toyah. The mass was then exhibited for a time in Fort Worth, Texas, where a small fee was charged for the privilege of examining it. Prof. G. M. Butler of the Colorado School of Mines was among the first to recognize the meteoric nature of the mass, his investigations having been made on a piece sent to him for testing. He obtained the usual figures of a medium octahedrite by etching, and determined by analysis the composition — Fe 92.20%, Ni 7.54%. Specific gravity 7.37. This information Prof. Butler kindly furnished the Museum through correspondence. In September, 1913, the entire mass, with the exception of about 5 lbs. that had been removed for testing, was secured by the Museum (Mus. No. Me 1946). It is an iron meteorite weighing 1,520 pounds (688 kgs.) and is thus of unusually large size. Like many other meteorites, the shape of this meteorite is a low, irregular cone, although the cone is so low that the form might perhaps better be described as shield-shaped, with the boss of the shield corresponding to the apex of the cone. Further, the shield has a roughly triangular rather than oval outline. On two sides of the triangle (one long and one short) the edge of the shield is about a foot (30 cm.) thick and is

nearly vertical or inclined inwards from front to back. On the remaining side the edge narrows down to close contact between the front and rear sides. The greatest and least diameters of the front surface of the shield are 32 inches (78 cm.) and 26 inches (68 cm.). The mass is well oriented, there being notable differences in the markings and appearance of the front or apical side as compared with those of the rear or basal side. The boss of the shield is not centrally located as regards the outline of the shield, but is much at one side. However, it appeared from the behavior of the mass in handling it for installation that this boss or apex is close to the center of gravity of the mass. The boss does not present a broad, smooth surface, as is frequent with meteorites of this form, but is roughened and furrowed. The furrows extend radially from the boss over a considerable part of the front surface of the mass. They doubtless mark the course of air currents which diverged from the boss as the meteorite passed through the earth's atmosphere. The tendency of a meteorite in passing through the atmosphere to acquire a conical form through the greater erosion by atmospheric currents of the periphery of its front is illustrated in the accompanying diagram, Fig. 1. The front portion of the meteorite may be considered as subjected to both vertical and lateral forces of erosion. The resultant force will therefore be represented by a diagonal which is greater than either and moves in a direction tending to produce a conical form. Other portions of the meteorite are acted upon by only one of these forces and hence are less affected. If the meteorite is relatively broad in proportion to its thickness, the lateral force becomes stronger and the broad surface tends to be maintained.

Passing from a consideration of the general form of the Davis Mountains meteorite to its superficial markings, its front surface will be found to be irregularly indented by depressions covering several square inches each. These are secondarily modified by smaller depressions which resemble the more usual meteorite pittings except that they are irregular and ill-defined. Interspersed with these depressions are long ridges, the longest of which extends in an irregular course from the boss to the most distant point of the meteorite. The surface of this ridge is marked by a brighter luster and lighter color than the rest of the mass. At the end of the meteorite farthest from the boss this ridge passes over the thick, perpendicular edge of the meteorite in a sinuous course. This is at the apex of the triangle. The ridge is also strikingly marked by a continuous series of striæ running in a direction nearly normal to its course. These striæ vary in length and depth, but none of them is over a foot in length or more than a millimeter deep. While in a general way they all take the same course, there are some deviations and some of the

longer ones are curved. Except at one point the striæ are confined to one side of the ridge, the perpendicular side shown in Plate III. On the other side of the ridge a small area shows striæ running parallel with the ridge and directed toward the boss. The ridge evidently served to deflect the air current on the perpendicular side at right angles, but on the other side, which was flatter, their normal, radial course was little

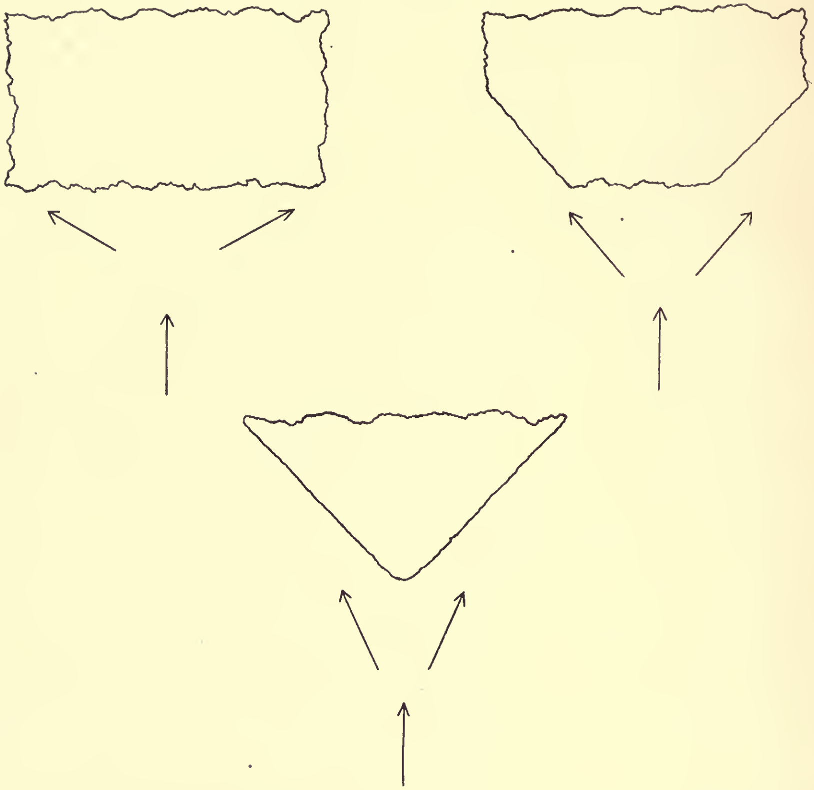


Fig. 1. Diagram showing how erosion by air currents tends to produce a conical form in a falling meteorite.

changed. The striated side of the ridge is also smoothed and presents generally convex rather than concave surfaces. Further, the slopes of the secondary depressions on this side are abrupt rather than gradual. Besides this main ridge, several smaller ridges produced by the meeting of broad depressions appear on the front surface of the meteorite, and besides the broad depressions and striations of the front surface there may be noted deep, narrow pits and crevices which penetrate into the mass of the meteorite. The longest of these is shown near the upper

right-hand corner of Fig. 1, Plate IV. This pit has a depth of about two inches, a length of about three inches, and a width of about one inch. Its depth is in the direction of movement of the mass. The edges and whole interior of the pit are rounded. At one end it runs off into a narrow and irregular crevice. Another pit of this same general nature may be seen below the boss in Fig. 1, Plate IV. It is smaller and shallower. Several cylindrical pits half an inch or less in diameter are also scattered over the front surface of the meteorite, their depth being in the direction of movement of the mass. A long, irregular crevice shown at the left in the side view, Plate III, may also be noted among the markings of the front surface. All these deep pits and crevices are probably produced by the melting out of some fusible constituent or the enlargement of some lines of cleavage. While the surface of the meteorite just described was undoubtedly the front one in descending, it was not the one upon which the meteorite lay. On the contrary it was that which was uppermost. This is shown by its greater brightness and smoothness as compared with the opposite side. A plainly marked soil line passes around the meteorite approximately along the median line of the edge of the shield and the discoloration and oxidation of the surface below this line show the mass to have been imbedded in soil to this depth. Like many other iron meteorites, this one seems to have turned on striking so that the front side lay uppermost.

The sides of the shield are, as has been said, in part perpendicular and in part sloping. Where they are perpendicular the meteorite is thick, where sloping, thin. The striæ of the ridge previously described pass partly over the thick, perpendicular side of the meteorite and as a rule terminate rather abruptly about half-way over the side. Along the line of termination may be seen partly turned-over edges like those which characterize other iron meteorites such as Algoma and N'Goureyma.

The rear side of the meteorite, shown in Fig. 2, Plate IV, is more uniformly and deeply pitted than the front side. The pits are broad, irregular, shallow depressions of a relatively uniform depth of one half to one inch (1–2 cm.). There are no striations on the rear side as there are on the front side. The pittings of the rear side are quite uniform in their general appearance except over a triangular area covering about a foot square and sharply depressed below the general surface. Here the pittings are much smaller and in addition numerous, slightly rounded, semi-angular protuberances project. These protuberances are evidently cleavage angles rounded by fusion. The area is shown at the right in the figure previously referred to (Fig. 2, Plate IV). This area was evidently produced by the separation of a portion of the meteorite

during the fall of the mass to the earth and the freshly exposed surface was less smoothed and pitted than that which was exposed during the entire course of the fall. As is usual with iron meteorites that have passed through several hands, this one has been cut and chiseled in various places in order to remove small pieces for examination or to test its hardness. The injury to the mass in this way has fortunately not been great, however. The largest amount so cut off has been from the portion which stands uppermost in Fig. 1, Plate IV. From this portion about 5 lbs. have probably been removed. The iron saws, breaks, or files rather readily, being comparatively soft. It is highly lustrous, and of a zinc-white color. Portions broken off show marked octahedral cleavage. The iron etches quickly with dilute nitric acid and shows octahedral figures of medium width. It belongs therefore to the class of medium octahedrites. The figures do not stand out prominently even on prolonged etching, but are sufficiently well marked for identification. The bands are relatively long, some being one inch (2.5 cm.) in length. They are also straight and considerably grouped. The kamacite appears to be granular rather than hatched and is remarkably homogeneous. The taenite borders are very narrow and rarely continue throughout the length of a band. As a rule they thin out and disappear though maintaining their direction. Fields are almost entirely lacking and where they do occur appear to be minute spaces bordered by taenite and containing plessite much darker in color than the kamacite. No accessory minerals, such as troilite or schreibersite have been observed by the writer in any of the sections thus far examined.

A chemical analysis of the meteorite was made by Mr. H. W. Nichols, the material for analysis being obtained from several borings with a 3/8 inch drill to a depth of one or two inches. As Mr. Duncan had stated that an assayer reported platinum in the mass, careful search was made for this metal in a separate portion. The method employed for determining platinum was a modification of that for determining copper in iron and steel.* The material used was in the form of very coarse borings which enclosed some thin seams of oxide. The weight taken was 5.1648 grams. This was placed in a Jena beaker and treated with 1:1 HCl cold. The beaker was placed on the edge of a hot plate and after action was well started, water was added from time to time in such quantities that solution attacked the borings with exceeding slowness. The solution was kept hot but not boiling and action was allowed to continue for two days, when the borings were nearly all consumed. The residue, which was coarse and black, was small in quantity and contained some undissolved iron. When this stage was reached the beaker was removed

* Lord's Metallurgical Analysis, 3rd ed., p. 163.

from the hot plate and cooled to room temperature. H_2S was then passed in to saturation and the solution heated very slowly to boiling and boiled for fifteen minutes, the current of H_2S being continued. A small black precipitate was formed which was filtered off and ignited in a porcelain crucible. The ignited precipitate was dissolved in aqua regia, evaporated three times with HCl, diluted and filtered. The residue, which was very small, was of brownish color, translucent and gritty. It gave no indication of the presence of any undissolved iridium. The filtrate was evaporated nearly to dryness, made alkaline with ammonia and a few flecks of iron filtered off and reprecipitated three times. The filtrate was of a very pale blue color. This filtrate, evaporated to a volume of a few drops in a porcelain crucible, was made acid by HCl and ammonium chloride and alcohol added to precipitate any platinum. A crystalline, pale yellow precipitate of ammonium platinic chloride was thus obtained. It was filtered on paper, ignited over a Meeker burner and weighed. The weight obtained was also checked by separating the platinum from the crucible and weighing it alone. The ignited precipitate had the appearance of a steel-gray film, with a granular surface which looked like a film of very fine sand with coherent grains. It was fairly firm and stood handling with ivory-pointed forceps without breaking. When boiled with strong HCl, it was unaltered. It dissolved in aqua regia without residue to a brown solution which was nearly opaque when very concentrated. After removal of chlorine and nitrous oxides by six evaporations to dryness with HCl, the solution gave a strong rose color with potassium iodide. The ammonium platinum chloride was reprecipitated, and appeared under the microscope as yellow octahedrons. No platinum vessels or instruments were used in any of these operations.

The total results of the various operations of analysis were as follows:

Fe	92.03
Ni	7.40
Co	0.32
Cu	0.001
Pt	0.03
S	0.11
P	0.11
Si	0.08
	100.08

The analysis shows that the meteorite has the composition characteristic of the medium octahedrites, with the addition of a small percentage of platinum, the largest that has yet been shown to be possessed by any meteorite. It is possible, however, that platinum is a more constant ingredient of meteorites than records show, since it is only within the last few years that it has been looked for to any great extent.

KILBOURN

This meteorite fell June 16, 1911, at about 5.20 P. M., on the farm of William Gaffney, 7½ miles northeast of Kilbourn, Wisconsin. The latitude and longitude of this locality are 43° 40′ N., 89° 40′ W. The only observer of the fall of the meteorite was Mr. Gaffney, and to him through H. Conrad Meyer of the Foote Mineral Company the writer is chiefly indebted for an account of the fall.

Mr. Gaffney states that at the time of the fall he was in his hay field about 20 rods from his barn. While there he heard a rumbling noise similar to that produced by a heavy wagon passing over a stony road. The noise, he states, was much louder than thunder. The day was close and muggy with no breeze and no sign of a local thunder storm. The noise lasted about three or four minutes. While it was going on Mr. Gaffney walked towards the barn and when he entered it the sound ceased. When he had been in the barn about a minute he heard a loud report like that of a cannon and saw a small stone strike the manger about 10 feet from where he was standing, rebound, strike the stone foundation of the barn, and then bury itself to a depth of 2½ inches in the hard-packed clay soil which formed the floor of the barn. Mr. Gaffney picked up the stone, but found it so warm he could hold it only for a second or so. It remained warm nearly three hours. When first picked up it had a straw color on its surface, but gradually assumed a black color. Neighbors of Mr. Gaffney within a radius of three miles heard both a rumbling noise and a report when the stone struck the barn. Fishermen at Lake Mason, near Briggsville, Marquette County, Wisconsin, about five miles east of Mr. Gaffney's place, also heard a rumbling noise. On examining the barn after the fall of the stone Mr. Gaffney found that the stone had gone through the roof, penetrated three thicknesses of shingles and a hemlock board about 1 inch thick; then, about 4 feet below this, passed through a ⅞ inch hemlock board forming the floor of a hay-loft. The portion of the floor of the hay-loft penetrated by the meteorite was submitted to the writer for examination, and a photograph of the same is shown in Plate VI. The hole said to have been made by the meteorite is about 4 inches long by 2 inches wide, and is about the size and shape that such a projectile would have made. The shape of the hole indicates that the meteorite was moving in the direction of its longest axis and not broadside when it penetrated the board. It does not seem to be possible to determine positively from the shape of the opening which end of the meteorite was in front, although the indications are that it was the pointed end. The meteorite fits the opening in the board a little better in this position, yet the opposite end of the

meteorite shows abrasion and removal of the crust in several places, in a manner that might have been caused by the striking of this end against boards. The penetrated board has the brittleness peculiar to hemlock and hence might offer less resistance to a falling body than some other kinds of wood. The barn stands in a north and south direction with the roof sloping east and west. The stone fell upon the east slope of the roof and appears to have come from a direction a little south of east.

The stone is comparable in size and shape to a man's fist. Its appearance on several different sides is shown in Plates V and VI. It weighed a little less than 2 pounds, the exact weight being 27½ ounces, or 772 grams. The specific gravity of the stone as a whole was 3.43. Its length was 4½ inches (11.5 cm.), width 3 inches (8 cm.) and height 2½ inches (6 cm.). One relatively broad, though somewhat rounded, surface forms a base from which the other surfaces rise more or less irregularly. These irregular surfaces nearly all show pitting such as usually characterizes meteorites, but the pits are especially numerous over the concave surfaces. The pits are shallow, irregular in outline, and have an average diameter of about ¼ inch (6 mm.). More unusual than the pitted surfaces are two nearly plane surfaces each of about one square inch (2.5 sq. cm.) in area which come together with a third slightly pitted surface to form a rather steep pyramid at one end of the stone. This aspect of the stone is shown in Plate VI. This end of the stone resembles a tool shaped for piercing or boring. On the edges produced by the joining of these three planes there is a marked smoothing of the crust, its surface being compact and glossy. This smoothing extended on one edge for about 4 inches (10 cm.), on the other two about one inch (2.5 cm.). It may have been due to the friction of passing through the boards of the roof and loft if this portion of the meteorite was in front, but whether such was really the case the writer is unable to state.

The meteorite when received was nearly covered by a black crust. Where the crust was lacking the lack was evidently due to abrasion from striking the barn and to the removal of portions by the finder for examination. The crust was dull, rough, thin, and adhered firmly to the interior. Under the lens its surface is seen to be covered by a network of little ridges of matter which had been formed by flowing when in a fused state. No definite drift of these ridges could be discerned. While much of the meteorite is covered with crust of this character over some surfaces the crust takes the form of little, dark, glassy spherules thickly scattered over the gray surface of the interior. The continuous crust is more or less penetrated by meandering cracks which give the surface a crackled appearance. While the general color of the crust is black, at the bottom of many of the pits and in the shelter of overhanging edges

it has a reddish color, indicating a higher oxidation of iron at these points. The color of the interior of the stone is gray, more or less tinged with brown from iron oxide. The texture is compact and so firmly coherent that it can be broken only with difficulty. Surfaces take a good polish. There is an abundant admixture of metallic grains in the stone. These are of small size and uniformly distributed. As seen on a polished surface they are very irregular in outline but at times elongated. They rarely exceed ½ mm. in diameter. Nearly all consist of nickel-iron but a few show by their yellow color that they are troilite. The siliceous ingredients of the stone are largely in the form of chondri, plainly distinguishable on a polished surface by their circular outlines. Some of the chondri are black in color, others are dark gray and others light gray. The largest chondrus noted has a diameter of 2 mm.; the average are about half that size. The chondri as a rule break with the stone but occasionally separate out, especially on polished surfaces. The megascopic characters seem to place the stone in Brezina's class of spherulitic chondrites.

Under the microscope, chondri are seen to largely characterize the structure of the meteorite though their quantity is not as great as in some meteorites. The ground mass is for the most part well crystallized, the crystals being large and with definite outlines. The prevailing minerals both of the chondri and ground mass are chrysolite and enstatite, chrysolite being the more abundant of the two. The chondri present the usual porphyritic, radiated and lamellar forms. Of especial note among the lamellar forms is one in which the lamellæ run in three directions at angles of 60°. The three series of lamellæ have different extinction angles and the border zone extinguishes in unison with one set of the lamellæ.

The crust is thin for a meteorite so coarse in structure and nowhere in the sections examined by the writer shows an absorption zone. The outer or fusion zone is very nearly one-tenth of the thickness of the impregnation zone. The thickness of the two zones combined approximates closely to 0.4 mm. The impregnation of fused matter from the surface due to the formation of crust affects the ground mass but does not penetrate the chondri.

MACQUARIE RIVER

This locality (spelled "Macquaire" River) was listed in the appendix of Wülfing's catalogue* and specimens were mentioned as possessed by Gregory, 58 grams, Paris School of Mines, 1 gram, and v. Siemaschko,

* Die Meteoriten in Sammlungen, Tübingen, 1897, p. 402.

3 grams. The classification was given as mesosiderite or pallasite, each with an interrogation mark, and the date of find as 1857. It was queried also by Wülfing whether this find should be united with Cowra. With the purchase of the Gregory collection by the late Prof. H. A. Ward the 58 gram specimen passed to Ward* who listed it as a mesosiderite and gave the locality as latitude 31° 30′ S. and longitude 152° 56′ E. Meunier† classed Macquaire River as logronite and described it as follows: "We have only a small piece of this meteorite; but in spite of its weight, which does not exceed 1 gr., there is sufficient for exact determination and without hesitation we include it among the type logronite." In the catalogue of the Berlin collection by Klein, in 1906,‡ 13.5 grams of Macquaire River were listed and classed (p. 13) as a mesosiderite. Klein also (p. 103) gave the following description: "Shows megascopically much iron but finely distributed. In this section the silicates appear much decomposed, but a little chrysolite is clearly seen." Anderson § listed Macquaire River among the Australian meteorites and its possessors as Ward-Coonley and the Berlin Museum. The above seems to be all the information that has hitherto been published regarding this supposed meteorite.

On the acquisition of the Ward-Coonley Collection by the Museum, the 58 gram specimen came to the attention of the writer and as some of its characters seemed unsatisfactory from the meteoric standpoint, it was given further study. The specimen is a fragment thinner than broad, having a polished surface of about 12 sq. cm. The unpolished surface is of iron-black color, the polished, nickel-white to bronze. The luster throughout is metallic and the mass is magnetic. The unpolished surface is rough without being jagged, but is especially marked by several pits, two of which are of elongated form while the others are circular. The diameter of the circular pits is about 2 mm. while the elongated pits are from 10 to 15 mm. long. These pits are too regular in form and have edges too sharp to correspond to the usual type of surface pittings on meteorites. The polished surface appears to the naked eye to be of nearly uniform color and luster, but with the lens shows numberless dots of a bright gray metal imbedded in a dull-black ground mass. The form of the individual dots is in general circular but they are usually grouped into elongated forms so that something of a pattern is given to the surface. The appearance of a mesosiderite is thus somewhat simulated, but the metallic dotting is more uniform and abundant than the

* Catalogue of the Ward-Coonley Collection, 1904, p. 31.

† Revision des Lithosiderites, 1895, p. 34.

‡ Studien über Meteoriten, Abh. d. Königl. Preuss. Akad. d. Wiss.

§ Records Australian Museum, 1913, Vol. X, p. 61.

writer has ever noted in a mesosiderite. Material for a chemical analysis of the specimen was obtained by boring to a depth of 2 cm. in the mass with a 5 cm. drill. This gave about 1.9 grams of a black, magnetic powder which was, except for a little gelatinous silica, completely soluble in hydrochloric acid. Analysis by H. W. Nichols gave:

Fe	70.72
Ni	0.23
Co	trace
Cu	12.35
Ag	0.17
Pb	0.78
Zn	0.94
Mn	trace
S	13.29
P	trace
C	0.35
$Si O_2$	0.27
	99.10

Al_2O_3, Ca O, Mg O, and alkalies were present in traces. The analysis shows the mass to be chiefly a sulphide of iron and copper with probably much of the iron reduced to the metallic form. It cannot be considered of meteoric origin. The small percentage of nickel may have given a qualitative test which led the original finder to assume a meteoric nature.

There seems to be little doubt that the material is of artificial origin, the result of some smelting operation. The piece may have been broken from some hearth accretion. In any case the evidence seems to warrant dropping Macquarie River from the list of accepted meteorites.

SOUTH BEND

The determination of the specific gravity of this meteorite by the writer in his original description* was called in question by Dr. Peter Tschirwinsky in a note to the writer in February, 1908. Dr. Tschirwinsky suggested that the value (4.28) obtained seemed low for a meteorite containing so much metal. Accordingly a new determination of the specific gravity was made by the writer, with the result that a value of 4.91 was obtained. Evidently some error was made by the writer in his first determination, and Dr. Tschirwinsky's kindness in pointing out such a probability is gratefully acknowledged. Using the new value to obtain a determination of the relative proportions by weight of the nickel-iron and chrysolite in the meteorite, the result is:

Nickel-iron 56.2% Chrysolite 43.8%

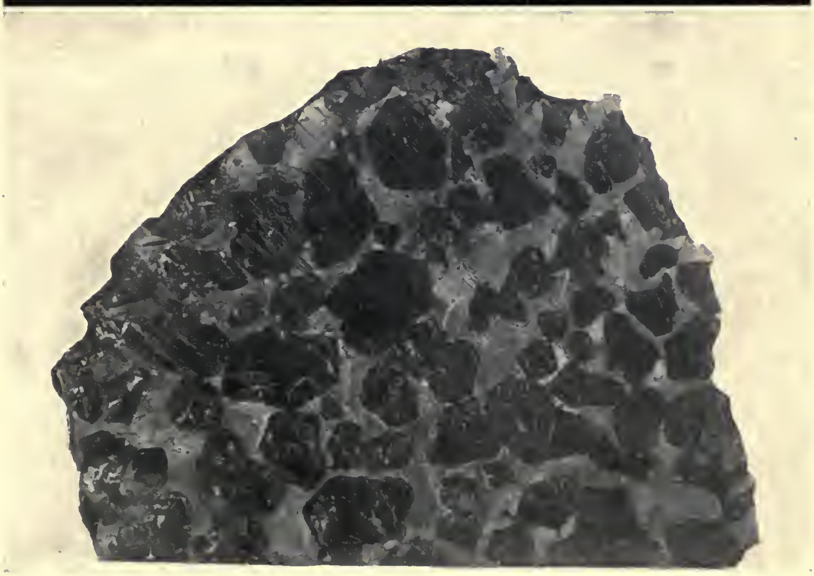
This ratio should be substituted for that previously given.

* Pubs. Field Col. Mus., 1906, Geol. Ser., Vol. 3, p. 20.

EXPLANATION OF PL. I.

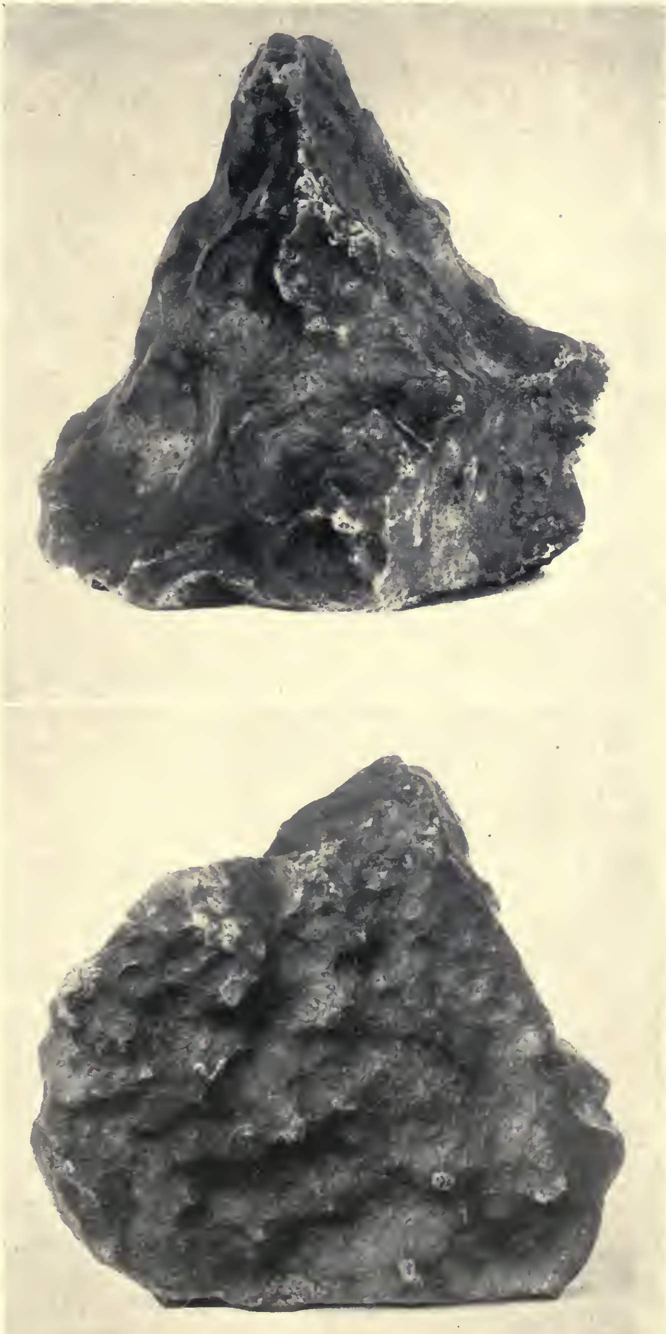
Upper figure, Fig. 1. Ahumada meteorite $\times \frac{1}{6}$.

Lower figure, Fig. 2. Section of Ahumada meteorite $\times \frac{3}{4}$. The dark portions are chrysolite, the light, nickel-iron.



EXPLANATION OF PL. II.

Upper figure. Side view of Bishop Canyon meteorite, $\times\frac{1}{2}$.
Lower figure. Rear side of Bishop Canyon meteorite, $\times\frac{1}{2}$.



Davis Mountains meteorite. Side view, $\times 1/5$. Grooving and smoothing by aerial currents is shown.

EXPLANATION OF PL. IV.

Upper figure, Fig. 1. Front side of Davis Mountains meteorite, $\times 1/8$.
Lower figure, Fig. 2. Rear side of Davis Mountains meteorite. $\times 1/9$.

EXPLANATION OF PL. V.

Kilbourn meteorite shown from opposite sides, ×¾.

EXPLANATION OF PL. II.

Upper figure. Side view of Bishop Canyon meteorite, ×½.
Lower figure. Rear side of Bishop Canyon meteorite, ×½.

Explanation of Pl. VI.

Upper figure. Board penetrated by Kilbourn meteorite showing character of fracture and orifice produced, ×1/4.

Lower figure. End view of Kilbourn meteorite, ×2/3.